

Three New Species of Onychiuridae (Collembola)
from a Korean Cave

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韓國洞窟産 어리톡토기과 3新種

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적 요

등굴산 어리톡토기과 (Onychiuridae)의 3신종이 강원도 정선군 북면의 "산호등굴"에서 채집 확인되어 *Onychiurus polychaetosus* n. sp., *O. longisetosus* n. sp. 및 *O. oblongatus* n. sp.로 명명 기재 하였다. 아울러 삼척군 신령굴에서 보고되었던 *O. izuruensis* 도 재기재 하였다. 강원도 영월군 고씨굴에서 신속으로 보고된 이후 (Yosii, 1966) 그동안 멸종된 것으로 생각되었던 *Gulgastrura reticulosa* Yosii, 1966 이 본 등굴 입구에서 다시 발견된 사실도 아울러 보고한다.

Key words: Onychiuridae, cave, taxonomy, Korea.

INTRODUCTION

There have been only a few works on Collembola from Korean caves (Yosii, 1966; Lee, 1974; Lee & Park, 1984) and those concerned with Onychiuridae were made only by Yosii, dealing with five species including two, new to science.

Among material from Sanhodong-gul cave in the mid-eastern part of the Korean Peninsula we came across three species of Onychiuridae, new to science, in addition to a species previously recorded from an other Korean cave, and we describe them in the followings. The types will be deposited in the Insect Collection, Department of Biology Education, Jeonbug National University, Korea.

COLLECTION SITE AND MATERIAL

The cave "Sanhodong-gul" is located near the top of the Mt. Banryun-san (alt. 1014m), at Yeoryang-ri, Bug-myeon, Jeongseon-gun of Gang-weon-do Province, one of the most karstic areas in the mid-east of Korean Peninsula. The entrance is on a steep north-facing hillside and is roughly triangular with a maximum height of 4.2m and 10m wide (Fig. 1A). Just inside the entrance starts a short but steep descent over about 15m distance, leading into a hall with the ceiling ca. 5m high and almost 18m deep. The slope is covered with a thick layer of litter over 13m downward (Fig. 1B). This entrance hall is followed by a gallery more than 10m wide (Fig. 1B), steeply going

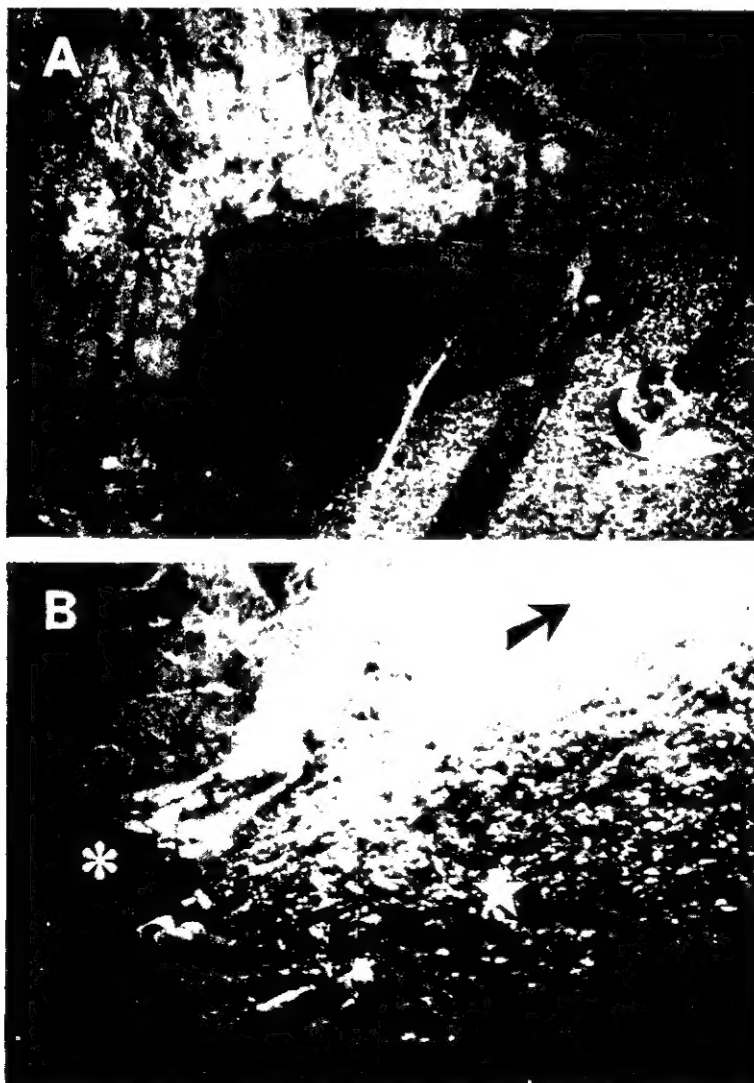


Fig. 1. A. Cave entrance viewed from outside, B. Cave entrance viewed from inside. Light source from outside indicated by an arrow. The litter area where *Gulgastrura reticulosa* Yosii was collected is shown by an asterik. The starting point of the main gallery from cave entrance hall is marked with "•".

down south-westward over a distance of 85 m, all along covered by rocks and gravels and apparently no moisture enough for any animal inhabitation. From this hall are two branches, the one straight on and the other eastward. The eastward one reaches a dead end 230m away, irregularly going up and down, with modest development of stalagmites and stalactites here and there. The south-westward gallery extends 30m horizontally; this ends in a sudden pothole, almost vertical, with a well developed high and wide ceiling above. The surveys were carried out only up to these points of easy access, beyond which special techniques were required for exploration.

The surveys were made three times in 1984, on January 29th, April 5th and October 22nd. Numerous individuals of Onychiuridae were collected from deep areas while *Gulgastrura reticulosa* Yosii were collected and apparently limited to the cave entrance as will be noted later again. They were put in culture vials and in alcohol. For ordinary microscopic observation they were cleared first with Marc André I and then mounted in Marc André II.

DESCRIPTIONS

Onychiurus (Paronychiurus) polychaetosus n. sp. (Fig. 2)

Body length up to 3.9mm. Quite white alive and in alcohol. Four antennal segments related as 1.0:1.6:1.3:2.4. Ant. IV with bilobed apical bulb. Third antennal segment organ provided with 5 setae, 5 papillae, 2 rods and 2 granulate sensory clubs. Postantennal organ composed of 30-36 compound elements (in a compact mass) (Fig. 2B). Labral setae 4/3,4,2, marginally without papillae.

Unguis slender, carinate, with a pair of lateral teeth but without inner one. Unguiculus setaceous, as long as half of outer margin of unguis, with an angular inner basal lamella (Fig. 2D).

Ventral tube with setae as 0/27~37/0 (Fig. 2E). Furcal rudiment absent. Anal opening T-shaped (Fig. 2F). Pseudocelli dorsally as 2,2/1(2),3(2),3(2)/3,3,3,3,3,0, ventrally as 1/0,0,0/1,1,2(3),0,0 and on coxal basis as 1,1,1. Two pairs of pseudocelli in the posterior margin of head located remote each other (Fig. 2A). Polychaetosis prominent and setal arrangement, hence, rather irregular and variable. Anal spines curving, 3/4 of unguis in length, situated upon large anal papillae (Fig. 2A).

Type data: Holotype ♀, Sanhodong-gul cave, Yeoryang-ri, Bug-myeon, Jeongseon-gun, Gangweon-do Province, Collection no. 84-43-3, 22.X.1984. Paratypes: 19, same data as holotype.

♂ and ♀ specimens were collected.

Remark: The present species resembles in general *Onychiurus yongyeonensis* Yosii, 1966 recorded from Yongyeon-gul cave in Korea. They are especially similar in pseudocellar formula, the only difference restricted to the occurrence of a pair of pseudocelli in the ventral head in the present species. They are well differentiated, however, by the shape of inner lamella of unguiculus and general chaetotaxy including that of ventral tube. Polychaetosis of the present species, in addition, is revealed to be an outstanding difference.

Onychiurus (Paronychiurus) longisetosus n. sp. (Fig. 3)

Body length 2.3mm. Quite white alive and in alcohol. General shape elongate and cylindrical. Four antennal segments related as 1.0:1.3:1.2:1.9. Ant. IV without apical bulb. Third antennal segment organ provided with 5 setae, 5 papillae, 2 rods and 2 granulate sensory clubs (Fig. 3B). Postantennal organ composed of ca. 17 compound elements, in two rows, in contact each other.

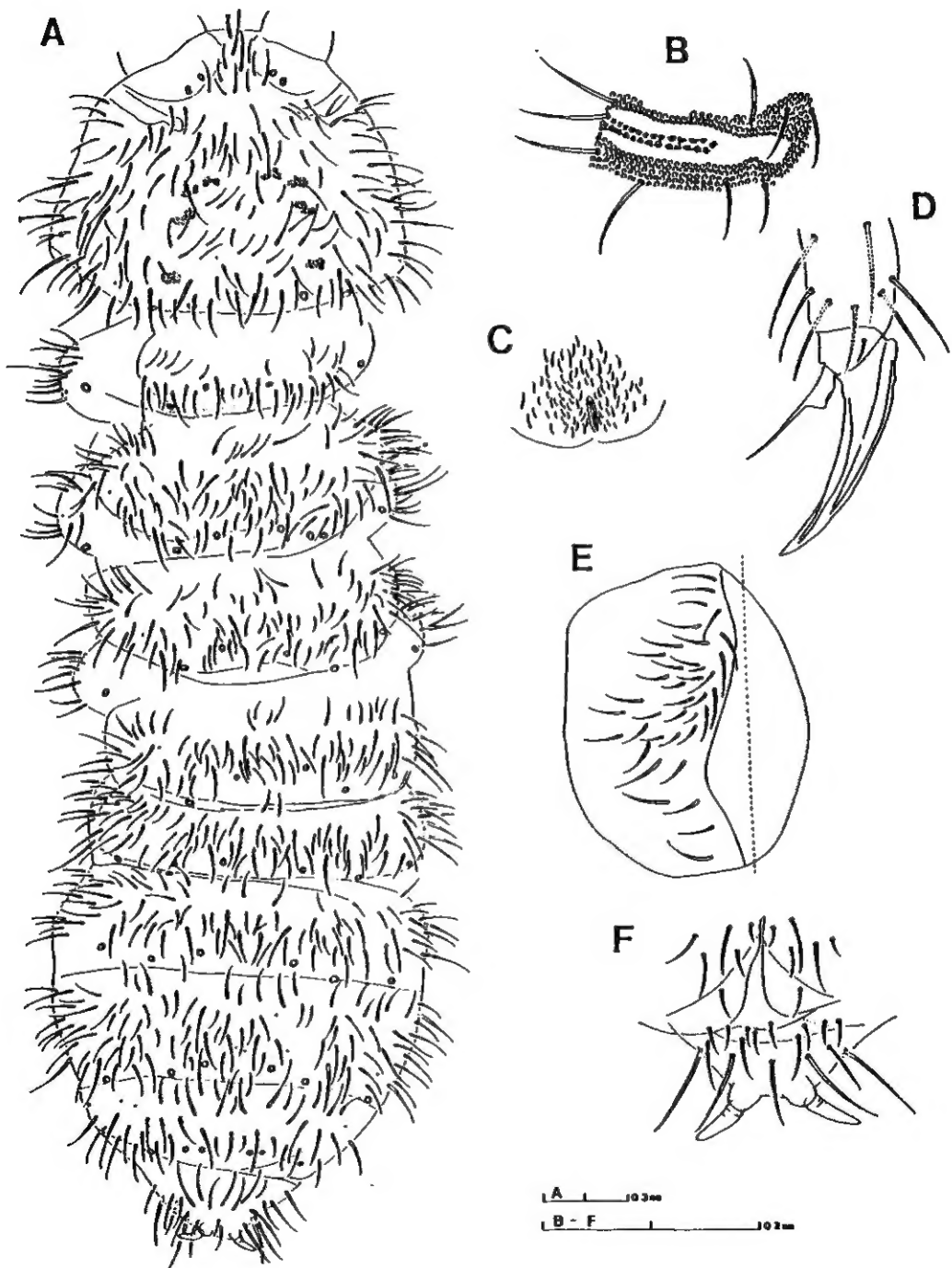


Fig. 2. *Onychiurus (Paronychiurus) polychaetosus* n.sp. A. whole body and the chaetotaxy. B. postantennal organ. C. genital organ ♂. D. hind claw. E. ventral tube with chaetotaxy shown only for left half. F. anal opening shown with anal spines.

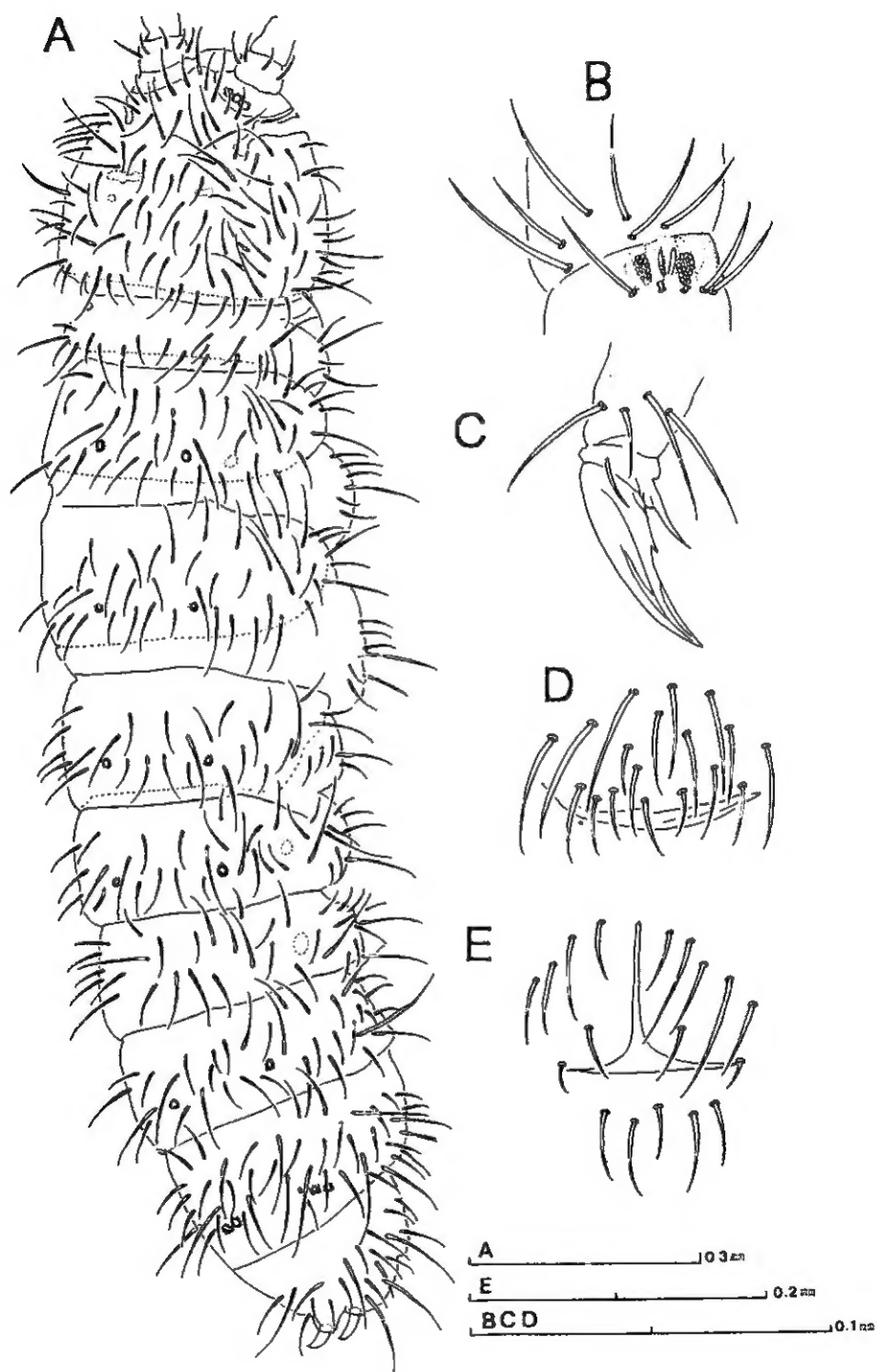


Fig. 3. *Onychiurus (Paronychiurus) longisetosus* n.sp. A. whole body with chaetotaxy. B. third antennal organ. C. mid-claw. D. genital organ ♀. E. anal opening.

Unguis carinate, with a very fine inner tooth. Unguiculus setaceous, with an inner lamella basally (Fig. 3C). Outer margin of unguis: unguiculus=3.1:1.

Ventral tube with 8+8 setae. No furcal rudiment present. Anal opening T-shaped (Fig. 3E). Anal spines curving, more than two thirds of unguis in length and mounted upon anal papillae. Granular development conspicuous in certain area of body surface, especially around pseudocelli. Pseudocelli located dorsally as 3,0/0,1,1/1,1,0,1(0),2(1) (Fig. 3A), absent ventrally and on coxal basis. Those on Abd. V situating very close each other. Body setae numerous and very long (Fig. 3A).

Type data: Holotype ♀, Sanhodon-gul cave, Yeoryang-ri, Bug-myeon, Jeongseon-gun, Gangweon-do Province, Collection no. 84-7-2, 5.IV.1984. Paratypes: 3, same data as holotype.

♂ and ♀ specimens were collected.

Remark: The present species seems to be allied to *Onychiurus (Paronychiurus) japonicus* Yosii, 1967 from a Japanese cave. Pseudocellar formulae, however, differentiate them, in addition to far longer setae, prominent granular development around pseudocelli and angular shape of inner lamella of unguiculus of the present taxon.

***Onychiurus (Paronychiurus) oblongatus* n. sp. (Fig. 4)**

Body length up to 1.8mm, white in color both alive and in alcohol. General shape elongate and cylindrical. Ant. IV without apical bulb. Four antennal segments related as 1.0:1.4:1.2:2.0. Third antennal segment organ provided with 5 setae, 5, papillae, 2 rods and 2 granulated sensory clubs. Postantennal organ consists of ca. 18 compound elements in contact each other.

Unguis carinate, without inner tooth. Unguiculus setaceous, with basal lamella (Fig. 4B). Outer margin of unguis: unguiculus=2.3:1. Ventral tube with setae as 0/8-9/0. Furcal rudiment with 2 small setae on a small elliptical swelling (Fig. 4C). Anal opening in T-shape (Fig. 4D). Anal spines as long as half of unguis and situated upon anal papillae. Body surface displaying distinct granular development. Pseudocelli located dorsally as 3,2/1,3,3/3,3,3,4,3,0 and on coxal basis 1,1,1.

Type data: Holotype ♀, Sanhodon-gul cave, Yeoryang-ri, Bug-myeon, Jeongseon-gun, Gangweon-do Province, Collection no. 84-7-2, 5.IV.1984. Paratype: 2, same data as holotype.

♂ and ♀ specimens were collected.

Remark: This species resembles *O. (Paronychiurus) flavescens* Kinoshita, 1916, the occurrence of which had been reported already from a Korean cave (Yosii, 1966). The pseudocellar arrangement in Abd. V, however, clearly separate them as distinct species, which is supported by additional evidence of the chaetotaxy of Abd. IV (Figs. 4A, E).

***Onychiurus (Deuteraphorura) izuruensis* Yosii, 1956 (Fig. 5)**

Body length 2.2mm. White alive and in alcohol. Third antennal organ is provided with 5 setae, 5 papillae, 2 rods and 2 smooth sensory clubs, the latter curved in the same direction (Fig. 5B). Postantennal organ composed of 16 compound elements, in contact each other. Labral setae 4/1,4,2.

Unguis carinate, without lateral and inner tooth. Unguiculus setaceous, with a broad inner basal lamella (Fig. 5C). Outer margin of unguis: unguiculus=1.6:1.

Ventral tube with 4+4 setae. No distinct furcal rudiment except two pairs of short setae (Fig. 5E). Anal spine absent. Body surface intensely granular, especially around pseudocelli. Pseudocelli located dorsally as 2,1,2/1,3,3/3,3,3,2, ventrally as 1,2/1,2,2/2,1,2,1,1. Coxal basis with 1,1,1 pseudocelli. Bodysetae numerous (Fig. 5A).

Material examined: 4, Sanhodon-gul cave, Yeoryang-ri, Bug-myeon, Jeongseon-gun, Gangweon-



Fig. 4. *Onychiurus (Paronychiurus) oblongatus* n.sp. A. whole body with chaetotaxy. B. hind claw. C. furcal rudiment. D. anal opening. E. Abd. IV and V of *O. flavesceus*.

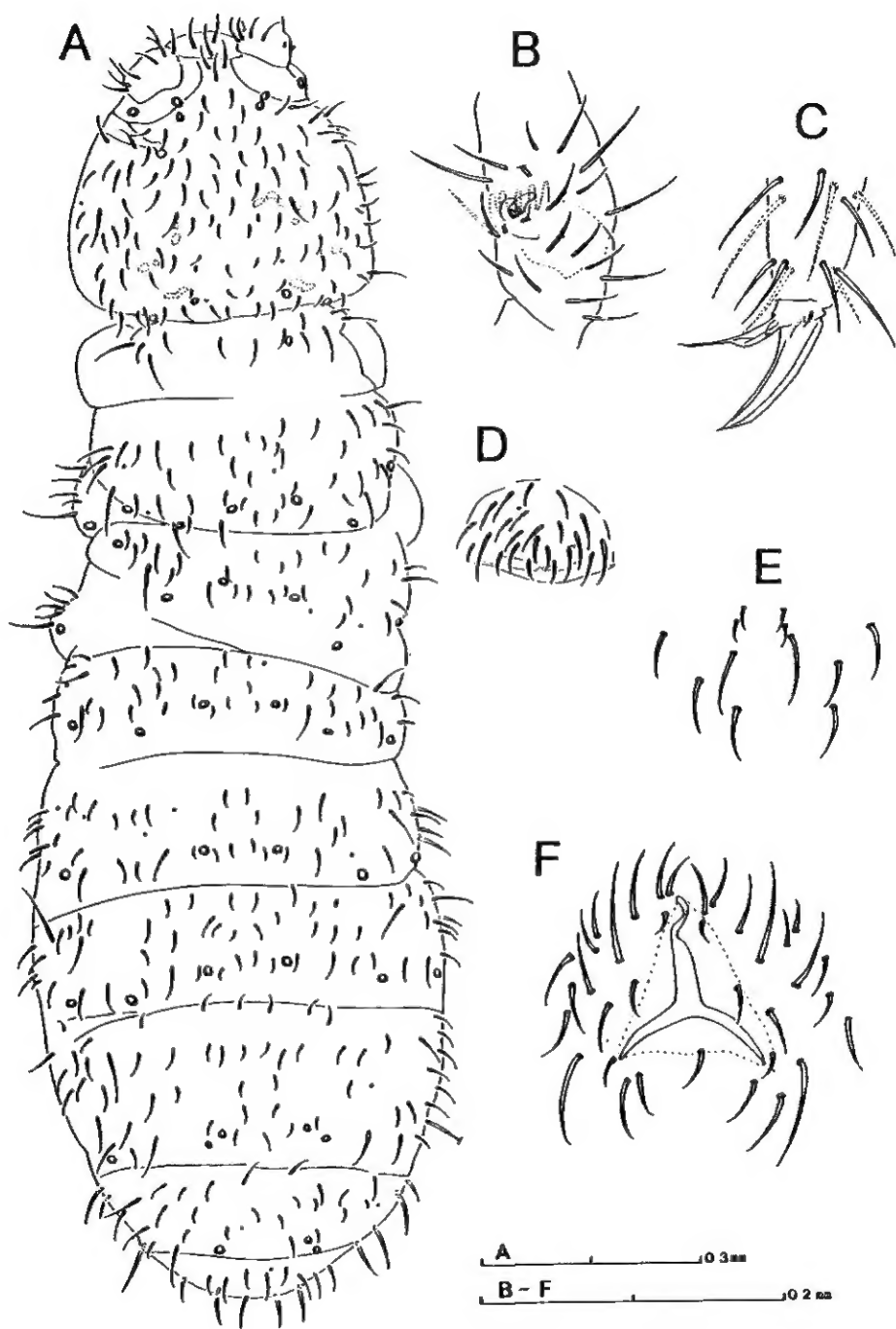


Fig. 5. *Onychiurus (Deuteraphorura) izuruensis* Yosii. A. whole body with chaetotaxy. B. third antennal segment organ. C. hind claw. D. genital organ ♀. E. Furcal rudiment. F. anal opening.

do Province, Collection no. 84-7-2, 5. IV. 1984.

Remark: This species was recorded from a Korean cave, Sinryeong-gul, Samcheug-gun, in the Province as the present one, by Yosii but without any taxonomical account. The present material is found to be in general agreement in most characters with those in the original description from a Japanese cave. Some minor differences were noticed, however, in the form of internal lamella of unguiculus, which is angular in the Korean specimen, and in body size. In addition, the present material is shown to be somewhat polychaetotic as compared to that in the original description.

Distribution: Korea, Japan.

DISCUSSIONS

All the species described above are characterized by polychaetosis and one of them, *Onychiurus longisetosus*, are covered with very long setae over the tergites, which certainly demonstrates sensory compensation of cave adapted organisms (Christiansen, 1961; Culver, 1982). The new taxa described above all belong to *Paronychiurus* group whereas another Korean cavernicoles presented here belongs to the subgenus *Deuteraphorura*. *O. longisetosus* has a distinctive pseudocellar formula while *Onychiurus polychaetosus* and *O. oblongatus* have the formulae similar to that of *O. yongyeonensis* Yosii and *O. flavescens* Kinoshita respectively. We attributed, nonetheless, specific status to each of them because of differences in occurrence or arrangement of some pseudocelli as well as chaetotaxical difference of Abd. IV. In this connection it may be referred to that the pseudocellar formula of Onychiuridae proved to be one of the most reliable and consistent characters as evidenced by a quantitative study by Hale (1968).

It is interesting that *Gulgastrura reticulosa* Yosii, 1966 which had been described as monotypic new genus of Hypogastruridae from Kosi-gul cave, about 40 Km away from the present locality, was also collected. It was considered extinct for almost two decades, due to the drastic environmental change of the type locality being transformed to a tourist cave. It is interesting, moreover, to note that the occurrence of *G. reticulosa* was confined to the cave entrance (Fig. 1B). A study of this species is to be published separately (Lee & Thibaud, 1986).

SUMMARY

Three new species of Onychiuridae were found from "Sanhodong-gul" cave of the Province of Gang-weon-do in the mid-eastern area of the Korean Peninsula. They were described as *Onychiurus polychaetosus* n.sp., *O. longisetosus* n.sp. and *O. oblongatus* n.sp., in addition to *O. izuruensis* already on record from one of other Korean caves. The rediscovery of *Gulgastrura reticulosa* Yosii, 1966, by accident, from the same cave has also been mentioned.

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